Title: Understanding the Response of Superconductors in Electrical Faults to Develop Resilient Power Dense Distribution Networks for Future Naval Applications

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Summary

United States Navy is moving toward all-electric ships and other platforms to enable next generation weapons and communications systems while at the same time increasing efficiency, operational flexibility and enhanced projection of force. To achieve these goals, a high power dense electrical distribution network is essential to move electrical energy easily, efficiently, and effectively. High Temperature Superconductors (HTS) that are already deployed for degaussing applications on ships are being developed for power system components. HTS power cables have been demonstrated to support the power densities required. Complex power systems often generate electrical faults during which the voltages and currents surge to values that are significantly above those of the normal operating conditions. Power cables on ships have to survive the faults without catastrophic damage. The proposed basic research effort will generate the knowledge essential to assess the response of HTS in fault conditions on future Navy platforms and to devise intelligent design features that will enhance fault tolerance and resiliency of HTS distribution cables. The proposed basic research will address the basic understanding and knowledge gap in the area of fault tolerance of HTS cables. The proposed research encompasses subsystem electrical and thermal models as well as experimental investigations. The results of this basic research effort will generate the knowledge base that will enable effective HTS cable designs that will be efficient, cost-effective, and contribute to resilient electrical distribution networks for Navy platforms.

The work will be performed at the Center for Advanced Power Systems of Florida State University located in Tallahassee, Florida. The Principal Investigator, Professor Sastry Pamidi and his research group members have extensive experience in HTS materials and devices and the Research Center have the required research facilities and equipment to effectively conduct the proposed research. The team has performed on several Navy related research projects and is knowledgeable in the Navy systems and needs.

The technical approach will involve literature study on various potential faults in the power systems of Navy platforms, investigations through computer models of HTS cables, and experimental investigations on HTS cable sections.

The personnel involved in the research effort are the principal investigator, research staff, graduate students at Florida State University and collaborators from Georgia Institute of Technology.

The outcome of this fundamental research is the knowledge that is essential to design fault tolerant power cables including HTS cables and to incorporate new design features to enhance protection and resiliency of HTS power cables and the power systems of Navy platforms.